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ABSTRACT

Student research programs offer students the principles and concepts of science, but also the opportunity to develop skills in other curriculum areas, including reading, language, problem solving, and writing. The brochure contains sections which specifically address the educational value of such programs, science days, project components, and implementation. A major section deals with planning and management of a science day, and includes information on: (1) scheduling; (2) judges; (3) volunteers; (4) performance criteria; (5) supplies; (6) floor plans; (7) programs; (8) publicity; and (9) awards. (TW)

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Why?

Student Research

One must learn by doing the thing; though you think you know it, you have no certainty until you try.

—SOPHOCLES (495-406 B.C.)

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The Ohio Academy of Science

Ohio's economy is linked to the world. Brains more than braun will be the driving force of the future. Educators, faced with a global challenge to provide students with increased opportunities in science education should implement a student research and science day program.

Student research is to science education as practicing is to music, as painting is to art and as scrimmaging is to athletics.

Science Is Basic

A creative student research based science program offers much to many. Science is for all students. Not only do students learn the principles and concepts of science, but also they develop skills in other curriculum areas including reading, language, problem solving and writing.

Reading skills, basic to survival in an information based society, are enhanced through a student research based science program.

Successful readers distinguish sounds, objects or symbols; develop a vocabulary of spoken words, and gain background experiences which add meaning to what is read. Science activities can provide students with all these skills.

Science process skills such as observing, inferring, interpreting data and drawing conclusions are directly related to such reading comprehension skills as getting the main idea, gathering and interpreting data, evaluating and drawing conclusions. These important skills are highlighted in nearly every reading workbook.

An inquiry-oriented science program is a means to language development. Confronted with a problem or situation, science students sort out factors, ask questions, discuss the investigative procedure and set up an experiment. Working in small groups, the students can orally communicate with their peers or to the entire class.

Science provides an ideal setting to develop critical thinking skills. Throughout life it is important to be able to identify factors influencing a situation or problem. Proposing an hypothesis or tentative explanation of a situation and then testing the hypothesis is a basic skill of lifetime benefit. The ability to predict outcomes for certain actions is a valuable skill enhanced by a strong student research based science program.

Writing is important in all disciplines. Students need to write. The Ohio Academy of Science urges schools to focus student research programs on research plan or proposal development, keeping a daily log, writing abstracts and preparing written reports.

Some programs may involve an interdisciplinary approach between science, English and mathematics teachers.

EDUCATIONAL VALUE

Few would argue that gifted and talented students should be involved with science, but the Academy feels that an activity based science program is valuable for all students.

Science relates to everyday life. Today's science-related public policy issues such as:

- population and hunger,
- agriculture,
- water resources,
- health care,
- environmental quality,
- and energy

must be understood by all citizens in order for them to make intelligent decisions as voters and as consumers.

Contrary to some popular beliefs, scientific knowledge is constantly changing. Thus, a scientifically literate person understands processes, attitudes, concepts and principles of science. A student research oriented science program stresses the value of continuous questioning, verification of data and respect for logical development of thought.

One has only to visit a classroom of students working on science investigations or attend a local science day awards ceremony to realize one of the most fantastic benefits of science inquiry — that of building a student's self confidence.

Creativity is the recombining of known things to make something unique. Science activities provide the content and opportunity to promote creativity.

Not all students learn the same way. Research provides evidence that hands-on activities involved in student research may help some students who have difficulties succeeding in traditional classrooms.

SCIENCE DAY OBJECTIVES

Science days — sometimes called science fairs — are occasions for the display and evaluation of student research projects. A successful science day program will achieve several objectives:

- to enable students to work toward maximizing individual potentials;
- to help students to improve their self concept and give them a feeling of accomplishment;
- to make students more aware of current issues in science;
- to give students the opportunity to participate in the programs of The Ohio Academy of Science and other youth science opportunities; and
- to enhance other curriculum areas.

PROJECT COMPONENTS

Projects in a successful science day program have four major components:

- an identified problem or question for which the student has designed an experiment to test an hypothesis, collected and analyzed data and drawn conclusions;
- a detailed research report;
- a physical display; and
- an oral presentation.

IMPLEMENTATION

The implementation of a successful science day program requires two phases. First, in early Fall prepare the students by following a class investigation plan. Acquaint students with project work by showing tape and slide presentations, or by simple demonstration using posters and pictures of previous science projects. Visual displays will give students an overview of project components and expectations. Students should be provided with a project component listing.

The entire class should be involved in at least one investigation prior to the selection of projects. Some science days or science fairs are criticized for displaying projects that are not scientific — those that are reports about a topic

rather than investigations of a problem. Students who have been involved with experimentation will be knowledgeable concerning the need to define a problem and suggest a procedure to test their hypotheses. When initiating a student research program, the entire class should complete a simple experiment to enable participation of all students in the discussion of variables, controls, validity and reliability.

A second activity may help to initiate appropriate questions for science investigations. Students should be in a lab team of two or more, be given science topics, and, as an assignment, write possible questions or problems that may be investigated.

For example, using energy as a topic, students may suggest investigating the effects of wind direction on the fallout of particulates from a coal fired electric power plant. A class follow-up discussion of the suggested problems of each lab team and the workability of each should be implemented. Select one of the suggested problems and discuss the scientific methodology that would be necessary to complete an investigation.

Continually stress the importance of a scientific method approach in solving a problem. Present and discuss as many investigations and methods of collecting data as possible to emphasize the importance of producing investigative rather than demonstration or report projects.

Guide students through the several steps for a successful student research project:

- plan ahead
- search for ideas
- narrow the topic
- identify a problem
- state an hypothesis
- locate information
- collect and organize data
- analyze and interpret results
- write report
- make a presentation
- be confident and proud of your work!

Although a teacher may assist students in all of these areas without actually doing any project work, the Academy urges students to seek mentors in local university and business communities for advice and guidance on research.

A time schedule is very important to the inexperienced project worker. Teachers should announce the project completion date and suggest reasonable check points to insure individual compliance. Also necessary for the teacher having several classes involved in project work is a check sheet for each student on which will be noted each time the teacher and student meet to discuss project progress. This enables a teacher not only to know at any given time what each student is working on, but also to monitor progress in outlining, note taking, location of references and collection of data. These records will aid in parent conferences and in determining the degree of pupil involvement in the projects.

Identifying a problem to study is often the most difficult aspect of a science research study. Brainstorming helps. Students should also consider newspapers, magazines, museums, parks, family, community, and hobbies.

After a student has been given an overview of what is expected and the criteria that will be used to evaluate his or her own work, the student is ready to assess personal goals and objectives and choose an investigation that will meet these priorities.

PLANNING AND MANAGEMENT

The second phase of a successful science day program is planning and management. Any successful program — regardless of size — requires planning and management. Students need direction. Administrators, including curriculum specialists and coordinators, can help manage a student research program.

The planning and management of a successful science day program is like a puzzle with nine pieces. Each piece must fit to get the overall picture.

Schedule

Clear the date and location of your science day with the school administration. Schedule the event at least two weeks before District Science Day. More than a dozen Ohio colleges and universities serve as centers for the Academy's District Science Days. Only by participation in one of these official districts can a student enter the annual State Science Day. Most teachers find that the last week of February or the first week of March is an appropriate time to schedule a local science day.

Volunteers

Initiate support from your school, from parent groups and from community organizations.

Judges

The major management task of the science day director is to recruit judges. Begin a list or set of cards with possible candidates and include their names, addresses, phone numbers and preferred judging category.

The first group to contact is the school administrative office personnel: superintendent, assistant superintendent, guidance counselor, curriculum supervisors, school board members and school nurses. Next, ask teachers and principals from other schools in the area. It is best not to involve any faculty who have direct contact with the participating students. Consider the community. Contact persons in the medical fields including veterinarians, optometrists, dental hygienists, pharmacists and lab technicians. Try local industries, colleges, universities, vocational and technical schools, senior citizen groups, professional societies, and local government. When determining the number of judges to be invited, consider the number of projects. Judges should spend a minimum of ten minutes with each student and should not be expected to judge more than seven projects.

The responsibility of acquiring qualified judges cannot be overstated. Students have worked months in preparing for this event and it is most important that they go home satisfied that they were evaluated by professionals in the field.

The Ohio Academy of Science has standards which must be communicated to students and judges. The Academy recommends that each student be judged by two judges acting either as a team or independently with the two scores averaged.

Judging Criteria

Projects should be evaluated based on four criteria:

- Knowledge achieved
- Effective use of scientific method
- Clarity of expression
- Originality and creativity.

To receive a superior award at a local, district or State Science Day, the student shall have an abstract and written report which documents that the student has searched relevant literature, stated a question and/or tested an hypothesis, collected and analyzed data, and drawn conclusions.

To ensure understanding of the four criteria, meet with the judges before they proceed to interview students. During this session, quickly cover the program objectives and what is expected of each participant. Be sure to mention that particular projects are to be evaluated by being compared to the criteria as stated in the Standards for Science Day, not one project versus another. Ask colleagues to review the project cards and exchange any cards as deemed necessary due to knowing the students, or having a project beyond their expertise. Discuss the criteria and answer any questions. Always give judges the flexibility to return a judging card or to request a second opinion on a project.

Supplies

Order supplies at least six weeks in advance of your science day. Include student entry forms and judging cards, name tags, record sheets, awards, certificates, folders for judges, and other office supplies.

Floor Plan

A floor plan will help organize the event and assist judges, students and visitors in finding specific projects.

Program

A printed program of student names and project titles is a nice keepsake for students and parents. A program has the added value of providing a way to publicly acknowledge the support for the science day by listing names of judges, cooperating teachers, school administrators and community sponsors.

Tally Room

Selection and supervision of the staff working in the tally room or office is also the director's responsibility. A professional atmosphere must prevail at all times. There should be no discussion of students personally or of judges or of the evaluations themselves. Only designated staff should be allowed in this room during the actual tallying of cards. As student judging cards are returned, they must be matched (if two evaluations were completed), the scores should be checked and averaged with a final rating assigned. The certificate is then located and the proper rating is stamped or handwritten. If ribbons and/or other awards are given, student names and other information can be added at this time.

Publicity

Advance and follow-up publicity is essential to increase community support and to obtain community recognition for students. Be sure to send releases to local radio, TV and newspapers before and after the event. Follow-up with phone calls to confirm receipt of the releases and to answer questions. Keeping a scrapbook of photographs and newspaper clippings will not only document your work, but you'll be able to use it when you seek support for next year.

Awards

All students deserve recognition for their project work regardless of their rating. The Academy has certificates for sale which can be given to each student.

Some science day directors give medals, ribbons and trophies. Consider seeking support

for special awards from local technical societies, Rotary, Kiwanis and other community service groups.

The awards ceremony should be well publicized and open to the public.

Summary

As you look to the future, establish a student research based science education program to meet the individual needs of all students in a global economy.

A successful student research and science day program will help you meet your educational responsibility and enable students

- to relate science to everyday life,
- to be creative in problem solving,
- to increase their self confidence,
- to use various learning styles, and
- to become scientifically literate.

The United States of America is a grand experiment in democracy. Among the variables in that experiment influencing this Nation's success have been the development of a system of popular education and the creation of a climate for research and development.

Few states can match the inventive genius and pioneering efforts in science, engineering and technology of Ohioans like the Wright Brothers, Charles F. Kettering, Thomas Alva Edison, Harvey Firestone, Charles Goodyear, Gordon Battelle, Michael Owens, John Glenn, and Neil Armstrong.

Significant segments of Ohio's economy, based on the efforts of these and other pioneers, include aerospace, automobiles, polymer chemistry, metallurgy, ceramics, agriculture, communications technology, and energy production.

Ohioans are rediscovering the links between the economy, quality education, scientific research and development.

Encouraging the youth of Ohio to do research on problems affecting our future is a worthy goal.

Why not start your program today?

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